

## Abstract

The performance of two different ocean data assimilation systems is examined here. We address questions such as: How do different assimilation methods impact the analyses, including ancillary fields such as salinity and currents? Is there a significant difference in interpretation of the variability from different analyses? How does the treatment of salinity impact the analyses?

Two ocean analyses over a nine-year period (1993-2001) are evaluated and validated with independent data. These analyses are generated by the GMAO (Global Modeling and Assimilation Office) and the GFDL (Geophysical Fluid Dynamics Laboratory). The same observation and forcing data sets are used in these two analyses. However, the ocean global circulation models (Poseidon and MOM3, respectively) and data assimilation methods (OI and 3D-VAR, respectively) are different. The GMAO analysis assimilates synthetic salinity profiles, based on climatological T-S relationships, in addition to observed temperature profiles (denoted by “TS-scheme”). The GFDL analysis assimilates the temperature profiles only, with the salinity field unchanged.

Compared with the TAO temperature data that have been included in the assimilation procedure, both analyses are superior to the GMAO control run (CTL; no assimilation), with the GFDL analysis having smaller bias than the GMAO analysis. Even though zonal current and salinity observations are not assimilated, they are impacted by temperature observation assimilation. Some aspects of zonal current variations are improved by the analyses. For example, compared with the TAO ADCP data, the analyses are generally closer to the observation than the CTL above the equatorial undercurrent core. However, below the undercurrent core, the CTL current is often closer to observations. Salinity bias is considerably reduced below the thermocline in the GMAO analysis, compared with the independent salinity data from the TAO servicing cruises. The salinity near the surface in the GMAO analysis is degraded due to the inappropriate use of the synthetic salinity data within the mixed layer. The GFDL analysis, which does not update salinity, has large salinity errors with peak RMSD close to 1.0 psu.

To discern the impact of the forcing and different methods of updating salinity, a sensitivity study is also undertaken with the GMAO assimilation system. An additional forcing dataset are used, and another scheme to modify the salinity field is tested. This salinity update scheme was developed by Troccoli and Haines 1999 (denoted by “T-scheme”). Our results show that both forcing and assimilation scheme impact the ocean analysis. Both assimilated field (i.e., temperature) and fields that are not directly observed and assimilated (i.e., salinity and currents) are impacted. Forcing appears to have more impact near the surface (above the core of the equatorial undercurrent), while the salinity treatment is more important below the surface that is directly influenced by forcing. Overall, the TS-scheme is most effective in correcting model bias in salinity and improving the current structure.